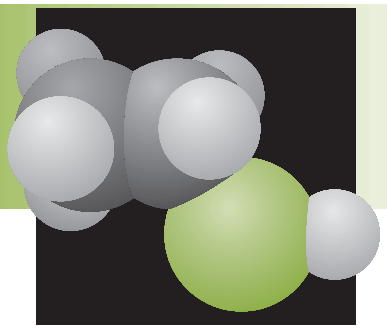
# CHEMICALS
**Project Fact Sheet**



# Manufacture of Industrial Chemicals from Levulinic Acid: A New Feedstock for the Chemicals Industry

## Benefits

- Saves 75.6 trillion Btu per year of energy by 2020
- Reduces wastes by 26.2 million tons per year
- Generates cost savings of $3.5 billion per year
- Utilizes inexpensive feedstock
- Potentially leads to numerous commodity chemicals derived from a "platform chemical"feedstock

## Applications

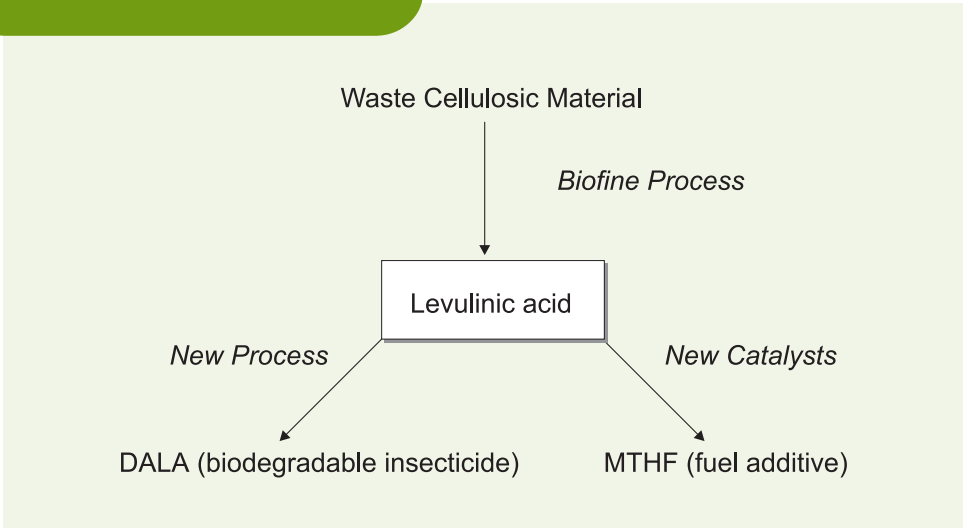
Levulinic acid (LA) has enormous potential as an inexpensive feedstock for producing a wide range of industrially important products. Two high-profile products have been identified that could expand the demand for LA to between 200 million and 400 million pounds per year: methyltetrahydrofuran (MTHF), a fuel additive, and delta-amino levulinic acid (DALA), a broad-spectrum herbicide/pesticide. Demonstration of additional commodity chemicals and intermediates that might be derived from LA will be important to attract potential financiers to this type of work, and to move new processes to commercialization.

## Inexpensive biomass material to be developed into a variety of products

A number of renewable feedstocks are used to produce chemical compounds that are valuable to the chemical manufacturing industry. An important measure of their value is how much it costs to produce these compounds. A new method for producing levulinic acid (LA) from biomass has significantly improved the cost effectiveness of supplying this versatile chemical "building block" to the industry. Moreover, the biomass used to produce LA can be derived from various sources: cellulose-containing waste materials from papermaking operations, recycled waste paper, and agricultural residues.

With the technology for producing LA from biomass already in the pilot stage, this project will focus on two potential applications for LA. One product is a fuel extender that could reduce the Nation's dependence on fossil fuels, and the other is a completely biodegradable herbicide/pesticide that will help protect the environment. The successful manufacture of these two products will significantly expand the use of LA by the chemical industry and open up markets for the new products. The new method may produce levulinic acid for only $0.04 to $0.10 per pound. The low cost reflects the significant energy savings and reductions in waste production possible with the new technology.

### Levulinic Acid Production




**Cost-effective supply of levulinic acid recovered from biomass provides chemical building blocks to industry.**

## Project Description

**Goal:** To scale-up the production of two chemical products that have significant commercial potential, using levulinic acid that was derived inexpensively from biomass.

The new technology for producing levulinic acid shows the potential of LA as a "platform chemical," able to stimulate a larger market because of other chemicals that could be derived from it. This project will focus on improving the production methods for two chemicals that have already been developed using LA: methyltetrahydrofuran (MTHF) and delta-amino levulinic acid (DALA). The MTHF process is more advanced than the DALA process, and will be subjected to preliminary testing in a batch reactor to evaluate various parameters affecting it (e.g., temperature, residence time, pressure). Catalysts will be developed for the hydrogenation step, and continuous-flow process testing will be carried out on a microscale to optimize the hydrogenation process. The actual products obtained from a pilot plant that is manufacturing LA will be used in these studies.

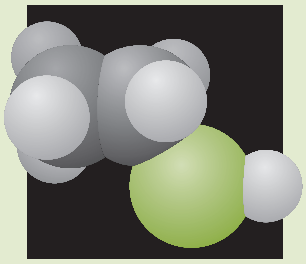
The DALA process will be improved in three areas: (1) Converting by-products of DALA production for use in plastics manufacturing; (2) using new reagents to simplify the production of DALA; and (3) purifying the final product to remove a salt generated during production. DALA and intermediates formed during DALA production will be tested for their herbicidal activity. To minimize waste streams, solvents and by-products will be recovered and reused at each step of the multi-step process.

## Progress and Milestones

- A 1-ton-per-day pilot plant to produce levulinic acid by the new method is in operation in South Glens Falls, New York.
- New processes for converting LA into two potentially significant products have been developed in the laboratory.
- Following process optimization for MTHF, a plant for hydrogenation of levulinic acid will be designed and constructed at the Glens Falls, NY, facility.
- The procedure for scale-up and adaptation of existing reactors for LA hydrogenation will be determined based on processing results from the microreactor system and input from the CRADA partners.
- Further work will involve scale-up of MTHF and DALA production, and completion of a prototype reactor for DALA, based on preliminary testing of a smaller-scale system.

## Patent Application

The Pacific Northwest National Laboratory and the National Renewable Energy Laboratory have received notification that their patent applications for MTHF and DALA, respectively, have been allowed.



### Project Partners

Biofine Corporation
Waltham, MA

Chemical Industry Services (a manufacturing agency representing 40 U.S. chemical companies)
West Lafayette, IN

National Renewable Energy Laboratory
Golden, CO

Pacific Northwest National Laboratory
Richland, WA

New York State Energy Research and Development Authority
Albany, NY


### For additional information, please contact:

Gloria Kulesa
Office of Industrial Technologies
Phone: (202) 586-8091
Fax: (202) 586-3237
Gloria.Kulesa@ee.doe.gov
http://www.oit.doe.gov/IOF/chemicals


Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

Visit our home page at
www.oit.doe.gov


Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

February 1999